

# Notice of Interest

## DE-AR52-11NA29853

January 7, 2011

This Notice of Interest concerning the release of a Broad Agency Announcement (BAA) to solicit research and development (R&D) regarding Nuclear Explosion Monitoring Research and Development (NEM R&D) is issued in accordance with CFR Part 35.016. Offerors should not submit a proposal in response to this Notice of Interest, but may submit a proposal after release of the solicitation.

**Description:** AFRL and NNSA will jointly solicit proposals for R&D to improve capabilities to detect, locate, and identify nuclear explosions. It is anticipated that this planned solicitation will be released on or about February 1, 2011 and close on or about May 26, 2011 seeking proposals with a period of performance of 1-3 years with awards starting in fiscal year (FY) 2012. Research products developed under this planned solicitation shall support Air Force requirements for improving the nuclear explosion monitoring capabilities and other U.S. verification needs.

The objective of this planned solicitation is to enhance U.S. capabilities in nuclear explosion monitoring primarily with ground-based systems. Proposals that enhance U.S. capabilities that also benefit the international monitoring capabilities in the context of preparations for a Comprehensive Nuclear Test Ban Treaty may be submitted. This will be achieved through advances in the state-of-the-art for nuclear explosion monitoring, basic and applied research that enhances understanding of the underlying phenomena, developing new methods of tackling monitoring problems, or gathering new data for use in nuclear explosion monitoring.

Individual proposals should be directed to only one of the topic sub-areas described below, but the Offeror may submit proposals in more than one topic sub-area. All topic sub-areas are of importance. However, depending on the proposals received and programmatic needs, funding may not be distributed evenly among the topic sub-areas.

Research is being sought in the following topic areas:

**TOPIC 1: Source Physics**

**TOPIC 2: Signal Propagation**

**TOPIC 3: Sensors**

**TOPIC 4: Signal Analysis**

**Topic 1: Source Physics**

**1a. Advanced Explosion Models.** Proposals are sought that complement existing efforts and/or propose new ideas to understand seismic energy generation from a range of sources (explosions, earthquakes, mine collapses, and other modes of rock failure), and how seismic energy is partitioned between P, S, and surface waves. Analyses that distinguish between

competing models for explosions are especially sought. New methods of estimating the yield of fully and partially -coupled explosions, and how emplacement conditions influence the observations, are of interest. Proposals for theoretical and observational investigations will be accepted under this topic.

**1b. Local and Regional Monitoring and Discrimination.** Proposals are sought that would produce new understanding of the properties of small seismic events and their seismic waveforms at local (200 km or less) and regional (2,000 km or less) distances. Innovative methods of event detection and location that are appropriate for local events are of interest. Of particular interest are methods for estimating yield of seismic events recorded at local distances with low uncertainty. New methods for discriminating explosions from earthquakes that have a firm physical and statistical basis are of interest. Methods that can discriminate chemical from nuclear explosions are also of interest. The physics of small seismic events, including the effects of emplacements, such as depth, is of interest.

**1c. Infrasound Studies: Seismo-Acoustics.** Proposals are sought on the interpretation of signals from co-located infrasound and seismic sensors at local and regional distances. A particular goal is the use of infrasound to assist in the interpretation of seismic events, including location and discrimination. Improved understanding of the fundamental physics of generation of infrasound from underground and near-surface explosions and other sources is desired, particularly understanding that can be transported to other geographic areas. The maximum infrasound signal expected from events that do not have a surface component of energy release, such as shallow earthquakes, and the nature of such a signal (impulsive or emergent) are of interest. Infrasound (and hydroacoustic) energy generated from events near the air-water interface are of interest. Experimental, observational and theoretical studies are of interest.

**1d. Hydroacoustic Studies: Phenomenology.** Proposals that quantify the types and variance of events and background noise at new stations are of interest. Proposals that mine existing data for reference explosive events and ground truth for discrimination are sought. Coupling from sources into hydroacoustic (and infrasound) energy and blockage in shallow water and near the air-water interface is of particular interest.

## **Topic 2: Signal Propagation**

**2a. Attenuation Models.** Proposals are sought to develop local and regional attenuation models, with emphasis on their ability to match observed amplitudes of Pn, Pg, Sn, and Lg phases, their codas, and surface waves. A question of particular interest is whether shear phases will be seen above the P coda over a particular path and at what distances and useful frequency range. Proposals to develop new methods for measuring attenuation, to estimate uncertainty (confidence, resolution, and variance) in attenuation models and predicted amplitudes, and to develop models that fit multiple datasets (e.g. body wave and surface wave amplitudes), are of interest.

**2b. Velocity Models.** Proposals are sought that develop advanced models of the Earth's velocity structure with predictive capability, especially in aseismic regions and in Eurasia. Of particular interest are: new techniques of determining 3-D, spatially variable velocity models; techniques for building models by fitting multiple datasets, especially of different types of data; techniques to estimate the uncertainty in geophysical models and assess the tradeoffs between different parameters of the models, as well as the uncertainty (confidence, resolution, and variance) in predicted observables, such as travel times; studies that compare different methods to show their strengths and weaknesses; and models that can predict structural effects on seismic

amplitudes at 1 Hz and higher as well as travel times. Priority will be given to studies of Eurasia. The influence of laterally-varying 2-D, 2.5-D, and 3-D structures, including 3-D scattering, on the stability of propagation of Pn, Pg, Sn, and Lg phases and how these phases propagate to local (less than 200 km) and regional distances (less than 2,000 km) are of interest.

**2c. Location and Discrimination Ground Truth, and Calibration.** Proposals are sought for seismic location calibration, collection of ground truth at a GT5 level (absolute location and depth errors less than 5 kilometers) or better in new areas, including dedicated explosions for events of magnitude 2.5 and larger. Research on new methods of acquiring location ground truth will be accepted under this topic. Studies that generate new discrimination ground truth events, along with source geometry and other characterizing information are sought. Calibration of regional coda magnitude is of interest. Improved techniques for event location using models and/or ground truth at local, regional or near-teleseismic distances, particularly methods that use more than a single type of data jointly are of interest. Robust estimation of uncertainty is an important consideration.

**2d. Infrasound Studies: Propagation.** Propagation of infrasound signals to local and near-regional distances (less than 1,000 km) is of interest, particularly the phenomenology governing reception and characteristics of infrasound signals within the so-called zone of silence. Improved understanding of the transition of infrasound from local to regional distances and the effect of this transition on infrasound signatures is of interest. Meteorologic observations that can validate competing models for reception of signals in the zone of silence are of interest. Improved identification of infrasound phases is needed, and better understanding of the infrasound waveform, including full-waveform modeling, is of interest. Atmospheric conditions that affect detection, phase association, yield estimation, and event identification are of particular interest. Another topic of interest is the uncertainty in azimuth and range determinations for infrasound signals from seismic events at local and regional distances, and improved methods of using all infrasound phases in seismic event location.

### Topic 3: Sensors

**3a. Infrasound Noise Reduction.** Equipment or techniques for reducing wind noise at infrasound stations is of interest, especially if it results in a substantially smaller footprint than current pipe arrays. The design of such equipment should take into account the characteristics of infrasound background noise; research into this subject may be proposed.

**3b. Infrasound field calibration.** There is interest in methods or equipment for field calibration of both amplitude and phase of infrasound sensors to at least 20% accuracy across the frequency band 0.5-5 Hz. Such equipment or techniques should have the capability to be easily applied to multiple sensors.

**3c. Radioxenon detection field equipment.** Rugged field equipment that does not require liquid nitrogen cooling to detect xenon isotopes is of interest. In particular, systems that use low power, detectors that are simple to operate (e.g., phoswich), have low memory effects and high radon rejection to enable field use are sought. Detection sensitivity goal should be as low as possible and the proposal must state a sensitivity goal and how this will be measured/tested.

### Topic 4: Signal Analysis

**4a. Signal Analysis.** We seek new and innovative signal processing methods for data from local (less than 200 km) and regional (less than 2,000 km) distances that significantly lower

the thresholds at which detection, location and identification functions can be performed at an acceptable false alarm rate. Methods that make use of more of the seismic waveforms than simply arrival times and amplitudes are sought. Methods that make use of full seismic waveforms, including waveform matching, are of particular interest. Studies should assess success and failure rates and the effect of less than perfect waveform matching. Estimating improvements in detection, including testing of detection processes using superposition of actual signals in increasing noise, is of interest. Tuning studies, either of specific arrays or of techniques in general, are not sought.

**4b. Synthetic Seismograms.** Innovative methods of computing synthetic seismograms for local, regional, and near teleseismic distances are of interest. Some topics of particular interest are 3-D computations in large models, efficient methods for 2.5-D calculations, hybrid or approximate methods that have significant advantages over other methods, methods that calculate spectra or envelopes, and computations at frequencies of 1 Hz and higher.

\*\*\*\*\*END OF TOPICS\*\*\*\*\*

The BAA will solicit proposals from all responsible organizations (foreign and domestic) including industry, academic institutions, research institutions, and non-profit organizations.

The United States Air Force Research Laboratory (AFRL), and the Department of Energy's National Nuclear Security Administration (NNSA) are strong advocates for the small business community and interested small businesses, small business-lead teams, and joint ventures that qualify as small businesses, are especially encouraged to submit proposals under this BAA.

Federal agencies may submit proposals as prime/lead contractors subject to appropriations language but may not partner with Federally Funded Research and Development Centers (FFRDC). FFRDCs, including NNSA national laboratories, cannot directly respond to this solicitation as prime/lead participants. FFRDCs, including NNSA national laboratories, may participate in this solicitation as team members; however, such participation must be consistent with the FFRDCs sponsoring agreement. The FFRDC effort for any proposal, in aggregate, shall not exceed 50% of the total effort of the project. Information will be provided in the solicitation on how to include FFRDCs, such as NNSA national laboratories, as a team member(s).

Enhancing programmatic value is encouraged. Low-cost proposals focused on validation or proof-of-principle issues will enhance programmatic value. Teaming is, also, an interesting way to add value, for example, teaming to facilitate integration of research products into the Knowledge Base will enhance programmatic value. Teaming which results in the training of graduate students (in particular university/industry teams working on real world problems with Ph.D. candidates) will enhance programmatic value. Programmatic value is addressed as part of selection criteria for proposals. If teaming arrangements are proposed, a clear statement of the intended benefit of teaming must be provided along with the proposed technical approach, deliverables and costs clearly delineated for individual team members. The Government reserves the right to award to the team or to individual team members.

AFRL and NNSA will require an annual progress report and a final report of each award, and will actively facilitate a successful transition to national monitoring and verification operations. Awards are eligible to have an NNSA Product Integrator (subject matter expert) assigned at the time of award to help ensure the successful transitioning of research products to operations. Information about the NNSA Nuclear Explosion Monitoring Research and Development (NEM R&D) program integration of research products into operational form for the Air Force can be found online at <https://na22.nnsa.doe.gov/KnowledgeBase>.

The funding organization reserves the right to determine which funding instrument shall be used. The funding instrument shall be appropriate to the scope of work and performing organization. In the event a contract is issued, acquisition regulations apply per 48 CFR, and a cost reimbursement type contract is anticipated. In the event a financial assistance instrument is issued, 10 CFR 600 applies, a cooperative agreement is anticipated.

The NNSA and AFRL each reserve the right to fund, in whole or in part, any, all or none of the proposals and to award without discussions between the funding organization and the awardee. Other Federal funding organizations may join this BAA action with signature of an appropriate federal official up to six months after the Source Evaluation Board meeting. This Notice of Interest is being issued in advance of passage of FY 2012 appropriations to provide more time for potential offerors to prepare and to allow awards to be made as early as practicable within FY 2012. The final number of topics and awards, however, are subject to the availability of funds.